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ABSTRACT

This paper offers a social learning explanation for age-related changes in children's cognitive functioning. Three hypotheses have been derived from the assumption of Piaget that structures play the preeminent role in cognitive development: (1) a child can not profit from or even appreciate experiences which are meaningful at a higher stage of development; (2) developmental changes in reasoning proceed according to an invariant sequence, never skipping a stage or reversing; (3) reasoning is assumed to be qualitatively homogeneous once a child is in a particular phase. Recent research relating to these hypotheses is reviewed. An argument is presented for a social learning formulation which assumes that concepts arise from experience, primarily of a social sort. Stage-like notions are rejected in the sense that stages are considered structurally discrete and homogeneous, and notions of immutable invariant sequences are eschewed. Logical rule-governed aspects of children's performance are not ignored or minimized. Rules are assumed to be acquired experientially, but to be much more limited in scope than in Piaget's model. However, prior rules are considered to affect subsequent experience. In general, this cognitive constructionist explanation is believed to be compatible with most of Piaget's notions. (MS)

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A SOCIAL LEARNING EXPLANATION FOR AGE-RELATED CHANGES IN CHILDREN'S CONCEPTUAL BEHAVIOR [1]

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Research on developmental changes in children's cognitive functioning during the last two decades has been dominated by the influence of Piaget's structural theory of intelligence. This formulation was perhaps the first fully comprehensive account of how children acquire adult reasoning skills, and it has stimulated a tremendous amount of research on age-related changes in children s cognitive functioning. All subsequent formulations such as the one I'll offer shortly were greatly influenced by Piaget's pioneering studies. However, I believe it is important to pull back periodically from any particular theory and reexamine the available evidence from another perspective if no other reason than to appreciate the power of the formulation anew. This is not easy since Piaget's theory is so intimately tied up with much of this data that it isn't easy to separate fact from interpretation. Today I would like to begin to advance an alternative social learning conceptualization in hope that it will provide a useful counterpoint to Piaget's notions.

Let me quickly summarize what I believe to be the main features of Piaget's structuralist approach. Piaget's theory was extrapolated from a biological model of development in which organisms such as a frog undergo discrete stage changes in the

process of becoming an adult. Piaget believed that children's thought evolved similarly in four major periods. He believed that a qualitatively different structure underlay children's reasoning during each period. All thought was determined by and restricted to that structure. Following the rationalist premises of continental European philosophers such as Kant, Descartes, and Rousseau, Piaget believed that the structures must be in place before a child can profit from experience because meaning is defined structurally rather than functionally to the environment (Inhelder & Sinclair, 1969; Strauss, 1972; Brainerd, 1975). Although not always evident at first reading, structures clearly play a dominant role over experience in Piaget's model (Furth, 1969). Since structuresdon't evolve from experience, maturation emerges as the key cause of structural change. However, Piaget suggested that maturation must be accompanied by some degree of experience for thought to emerge. Thus while maturation isn't the sole determinent of cognitive growth, it is the major factor.

Three major sets of testable hypotheses were derived from the assumption that structures play the pre-eminent role in cognitive development. First, a child can not profit from or even appreciate experiences which are meaningful at a higher stage of development. Second, developmental changes in reasoning proceed according to an invariant sequence, never skipping a stage or reversing. This hypothesis was advanced on the assumption that advanced structures incorporate and permanently alter prior existing structures. Third, reasoning is assumed to be qualitatively homogeneous once a child is in a particular phase (structures of the whole). This hypothesis follows from

the assumption that children's thinking is determined by a unitary structure. In general like all structural theories, Piaget put almost all of his emphasis on the logical aspects of thought, and stimulus properties of logical tasks were given relatively little attention. These then were the major hypotheses which were derived and tested vis-avis Piaget's model. Research studies have been undertaken to verify these hypotheses and early research conducted by Piagetians was interpreted in support of them.

Let us reconsider these hypotheses in light of recent research. The first concerns whether children can profit from experience which is meaningful only at a higher stage of development. The major research bearing on this topic has resulted from training studies of conservation. Because of time constraints, I will confine my comments to conservation phenomena. Early studies conducted by Piagetians (reviewed by Flavell, 1963) found no training effects. But there has been a long list of subsequent studies which have reported positive results (Brainerd, 1977). In general, reactions of many Piagetians to these studies has been either to assume that the children already had achieved the structure but didn't adequately manifest it (the so-called transition children) or to deny that the training outcomes qualified as true conservation according to Piaget's most demanding criteria.. Even though the early Piagetian studies focused only on conservation judgments, more demanding criteria were raised with regard to critical studies. For example reasoning was then required which puzzled many of us since Piaget had always maintained that cognitive development was separate from language development. Later other criteria were mentioned such as the ability to resist counter suggestion, transfer to new stimuli

or different conservation dimensions, need for perfect performance, and recall over time. Some of these criteria seemed quite reasonable such as transfer and recall whereas the ability to resist counter suggestion seemed to be fraught with conceptual difficulties. The demand for perfect performance seemed both excessive and inconsistent with the performance of so-called natural conservers. While not every training study met all these criteria, when considered as a body, all criteria were met in one study or another. However, some Piagetian scholars continued to raise more demanding criteria.

This culminated (hopefully) in Kuhn's (1974) critical review of conservation training studies in which she dismissed all previous research since these studies didn't meet what she believed to be Piaget's most demanding criterion: continued improvement in conservation performance after training had ceased. To my knowledge this was the first time that this criterion had been raised. Recently a modeling training study has been reported by Charbonneau, Robert, Bourissa, Gladu-Bissonnette (1976) which met even this criterion. They found significant continued generalization of a conservation rule over a several month post training period. Together these studies indicate conservation skill was acquired no matter what operational definition was favored.

The second line of reasoning advanced by Piagetians was to accept these training results as real but to question whether or not the child already had acquired the structure. This argument was complicated by the fact that there was no operational definition for this structure which was independent of conservation performance itself. Several compromises were suggested. One was to assume the absence of the structure if the child utterly

failed to conserve at all during pretesting. However, there was ample evidence that zero baseline subjects can learn (e.g. Rosenthal & Zimmerman, 1972) Another suggestion that was advanced was to train four-year-olds. I am not sure about the theoretical basis for this suggestion since Piagetians roundly assert the independence of stage and age in their formulation. My guess was that this suggestion was advanced a) because four-year-olds showed zero baselines as an age group on conservation tasks and b) at the time there were no successful training studies reported with children this young. Since this time there have been at least three successful studies (Denny, Zeytinoglu, & Seltzer, in press; Rosenthal & Zimmerman, 1972; Zimmerman & Lanaro, 1974). There seems to be little doubt that very young children can learn to conserve even though they display no pretest evidence of conservation skills.

Piagetians have put great emphasis on the limiting role of a child's cognitive structure in affecting his reaction to experience on the basis of what I will term "transition research." There were a series of approximately five studies (see Brainerd, 1977) which indicated that children's pretest conservation scores correlated reasonably highly with posttest scores. Piagetians interpreted these data as indicating that a child's degree of structural development affected his response to conceptual experience of a higher stage level. Recently Brainerd (1977) has questioned this conclusion. He cogently argued that this analysis was flawed because posttest scores reflected not only training effects but also pretest differences. Thus there would have to be some correlation between pre- and posttest scores. He recommended that a better analysis would be

to hold the pretest scores constant and thus remove them as as source of bias from the posttest scores. When he performed this analysis on the available studies, he found no evidence that transition children learned any better than zero baseline subjects. Brainerd's work appears to undermine the empirical basis for the transition argument.

A second set of hypotheses concerns whether reasoning follows an invariant sequence pattern and whether it can be reversed. The invariant sequence argument has received some degree of support. But at its most formal level Piaget's (1970) hypothesis is fairly general: that children cannot skip a major period of development such as going from the preoperational to formal operational thought. At this level of specificity, few would question that there would be a high degree of sequential regularity, At the same time, there are many nonstructural reasons for these regularities such as experiential regularities accompanying age and interdependencies of responses. More about this later.

With regard to the hypothesis that no reversals in cognitive development are possible, the evidence is contrary. This research on reversing development permits perhaps the clearest, most unambiguous tests of Piaget's structural theory. Several studies (Kingsley & Hall, 1967; Miller, 1973; Rosenthal & Zimmerman, 1972) have reported that when "natural" conservers are exposed to fabricated nonconservation experiences, these children readily adopt a nonconservation rule and generalize it. It also appears that older weight conserving children (who presumably have fully attained this stage of development) are no less resistent to nonconservation experience than younger weight conservers (Miller,

1973). To my knowledge, there has been only one attempt to refute this research, a study by Stauss and Liberman (1974) and that study was replete with experimental problems. Thus it appears that logical responses such as conservation are sensitive to experience and that developmentally "immature" responses will be adopted if they appear to be functional in discribing the environment.

The final assumption that derives from Piaget's model concerns how homogeneous cognitive functioning is for a child, the so-called "structures of the whole" notion. That is, a child within a particular cognitive period should display the same type of logical performance on tests of considerably different stimulus properties since the logical structure is the prepotent factor. In this regard, decalages or the fact that different types of conservation are mastered at different ages is not well explained by Piaget's theory even though decalages are widely acknowledged by Piagetians. Brainerd (1975) has argued that systematic emergence of subskills such as transitivity before conservation violates Piaget's assumption that each stage "emerge in tight synchrony." He concluded that only if the subskills emerged in a nonsystematic order would this support inferences of a singular conceptual structure since the subskills are assumed to be manifestations of the same underlying structure. For example, among other within stage sequences, Brainerd found that relational groupement structures appeared to precede each of the classificatory structures, and he concluded that this was inconsistent with the structure of the whole notion. There is other evidence that situational and stimulus factors affect

cognitive functioning. Uzgiris (1964) found that children consistently conserved with discontinuous quantity before with continuous stimuli no matter what type of conservation was involved. Together this evidence suggests that there some basis to question the structural consistency assumption. This topic deserves additional research before unambigous conclusions can be drawn.

What cognitive developmental phenomena must be explained in view of this recent research? First, decalages and some sequential regularities such as conserving with discrete stimuli must be explained. These within-period consistencies must be explained as well as between-period regularities. Also the failure to perform consistently on all relevant logical tasks must also be explained. Second, the sensitivity of children's logical functioning to experience must be explained, including developmental reversals as well as precocious training results. Third, the degree of transfer from training in logical operations must be accounted for.

A social learning formulation assumes that concepts arise from experience, primarily of a social sort. Stage-like notions are rejected in the sense that stages are considered structurally discrete and homogeneous, and notions of immutable inveriant sequences are eschewed. This does not mean that logical rule-governed aspects of children's performance are ignored or minimized. Quite the contrary, rules are assumed to be acquired experientially but are assumed to be much more limited in scope (constrained by stimulus factors). No single monolithic cognitive structure is postulated. Prior rules are assumed to affect subsequent experience. But unlike Piaget's theory, these rules aren't considered immutable to experience but instead are

assumed to change reciprocally from the very experience they help organize. Thus this social learning formulation is constructionistic in a cognitive sense, yet the logical basis for this activity is not seen as being fixed even for adults. This formulation directly follows from Bandura's (1976) reciprocal dependency of behavior postulate. This means that reversals might be expected if experience is concordant with developmentally immature rules.

In addition prior rule learning can be expected to affect subsequent rule learning. This means that learning complex rules often presumes knowing more elementary rules, and that once a rule is formed, more experience may be necessary to alter responding than if no rule had been induced. A social learning formulation is similar to a Piagetian model on these issues. However, social learning psychologists differ in believing instead that hierarchies must be demonstrated functionally (by transfer from training) rather than being assumed from developmental regularities. Hierarchies are also generally assumed to be much more limited in scope than Piaget assumes. Rules and hierarchies of rules are viewed as being ultimately dependent on functional factors and are never seen as being entirely internally self-justifying. Gagne's (1968) approach would be an example of what I have in mind by hierarchies.

I have argued elsewhere (Zimmerman & Lanaro, 1974) that decalages can be explained on the basis of at least three factors: a) the frequency of a social display of a rule, b) the degree of verifiability of a particular conservation rule, and 3) familarity with properties of phenomena or subrules

concerning it. Thus conservation of number would be expected to be learned before weight since number is much more commonly used and therefore modeled for a child. The fact that discontinuous stimuli are conserved before continous stimuli reflects the fact that counting skills or a child's skill in estimating small sets of objects can be used to verify conservation judgments.

The social learning formulation I'm advancing sees logical judgments as involving two elements: a rule and also stimulus elements. This corresponds to Haygood and Bourne's (1965) discription of concepts. Thus rules are never seen as being fully abstracted from a stimulus context as I believe is implied by Piaget's notion of structures of the whole. A conservation rule is learned in certain contexts and applied discriminatingly based on direct experience and prior rules and experience. Thus transituational generalizability is not assumed but must be explained on the basis of stimulus factors as well as knowledge of rules. Physicists (Feynman, 1965) have pointed out that conservation for example is not a law of nature; that changes in shape does alter some properties of stimuli such as area. Thus it is no surprize that adults may fail to conserve area when mistakenly applying a compensation rule (Russel, 1976) In addition, there are many stimulus transformations in nature that aren't reversible. A social learning orientation views logical functioning from a stimulus-constrained perspective. Thus abstraction is not a property of mind per se but instead is related to the variety of instances in which concepts are exemplified in the environment This formulation does provide a basis for explaining inconsistencies as well as consistencies in children's cognitive functioning.

How can social learning theory explain between-period changes in conceptual functioning such as a child's acquisition of conservation rules? Another way of asking thisquestion is why are children's concepts initially perceptual in nature? I believe that perceptual features of stimuli are more salient than quantitative ones. There is extensive research particularly that reported by Bourne, Haygood and colleagues that salient cues are tested first on concept learning tasks. The second point I'd like to make is that conservation is an <u>atypical</u> phenomenon. How often is it that the perceived amount (spatial dispersion) of stimuli will conflict with the actual amount? Rarely I venture. Thus the age-relatedness of conservation responding rests on the shift from the most salient to less obvious cues such as the inital equivalence of stimuli. Why the shift? Am I saying the contingencies suddenly changed for children around age six?

No, the explanation I'm advancing is not solely based on concurrent environmental factors. Environmental factors of the immediate situation seldom provide complete, unambiguous information. Feedback is often lacking, delayed in time or incomplete; nor is the behavior of models always definitive. Often instances of a concept are encountered irregularly, and thus extensive confounding can be expected from learning in the natural environment. A child's prior rule learning will be used as the basis for constructing tenable explanations for phenomena in these informationally-impoverished situations. I have found in recent research (Zimmerman & Jaffe, 1977) that age-related differences in vicarious learning only occur under conditions of partial information. Under these condi-

tions, the child will "construct" concepts which best fit the situation and obvious stimulus dimensions will be seized upon first. Prior rules (or structures if you prefer) will guide this constructing or transfer process.

Two important events happen to children around the age at which concrete operational performance appears. First the child has just acquired fairly complete language skills. Second children begin formal schooling at this time. Language allows the child to learn from indirect verbal experience and the school provides setting wherein concepts are taught primarily in just this manner. Undoubtedly the stimuli used for concept learning change greatly from real life objects and events to symbols such as numerals and to less complicated stimuli such as geometric shapes. This change in stimuli and mode learning (taught rather than inducing from vicarious experience) can be expected to change the relative salience of stimulus dimensions and the nature of the instances of the concept encountered. Atypical instances can be presented with the same frequency as more typical instances. Thus it isn't surprizing to me that the nature of children's concepts change abruptly at this age. There is evidence (Bruner et al, 1966) that acquisition of conservation is delayed in societies where children's entry into school occurs at an older age.

Thus I am suggesting that the phenomenon of conservation is not simply a product of momentary environmental contingencies. The environment is seldom informationally complete enough to permit unconfounded concepts. When it is, such as in training studies, we find that even very young children can acquire conservation rules. When children induce concepts from

informationally incomplete experience, their anomalous concepts may show some degree of regularity such as focusing first on perceptual cues. This social learning explanation was drawn from Bandura's (1976) four process model. Concept learning is only partially determined by concurrent antecedent and consequent stimuli; according to Bandura this information is usually cognitively interpreted and the basis of prior rule learning.

I realize that this account is not complete but is merely suggestive. A complete account is both beyond the available data at this point and outside the time constraints of this symposium. I do believe that the social learning explanation begun here has several advantages relative to structuralist formulations in explaining children's conceptual development. Because of time constraints, I will simply summarize them for you. a) It permits explanations of short term effects of experience on childrens cognitive functioning as well as long term effects. b) It avoids the need for cognitive readiness

assumptions, and yet allows for differential learning from a common conceptual experience. The phenomenon of cognitive constructionism can be explained, and the impact of prior rule learning can be taken into account. c) It requires fewer assumptions than Piaget's model. d) It is more flexible than Piaget's model. Concepts are viewed as less absolute and more adaptable to phenomena in the environment. e) It both allows for and suggests a form for human interventions into children's conceptual development. f) Finally I believe that it is essentially quite compatible with most of Piaget's notions. It does require that structures be seen as being more contextually related and sensitive to experience. But I view those features of Piaget's theory as being more philosophical than empirical.

I will close by reaffirming our enormous debt to Piaget. His work ranks as one of the single most important contributions to psychology and education. What I have tried to do today is to distinguish between his theory and findings and to indicate how his work can be integrated with one of the more conceptually flexible versions of an American associationistic theory, social learning. I personally believe that such an integration is not only useful for social learning psychologists but is also necessary before the full impact of Piaget's work will be realized.

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